and AB is the spurious-free dynamic range. Note that GH is the dynamic range, which is defined by

$$\text{DR} = GH = EH = P_{\text{in,1dB}} - \text{MDS}_{\text{in}}$$

The IP3_{in} and IP3_{out} differ by the gain (or loss) of the system. Similarly, MDS_{in} differs from MDS_{out} by the gain (or loss) of the system.

PROBLEMS

5.1 Calculate the overall noise figure and gain in decibels for the system (at room temperature, 290 K) shown in Fig. P5.1.

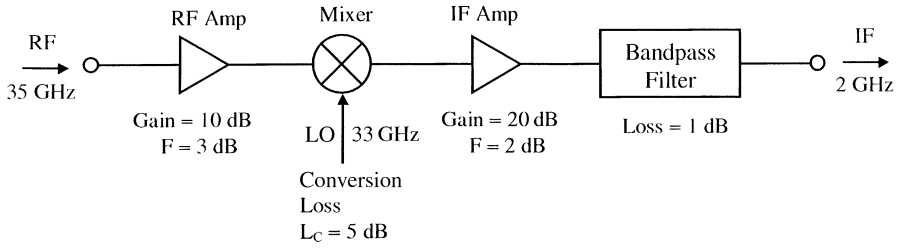

FIGURE P5.1

5.2 The receiver system shown in Fig. P5.2 is used for communication systems. The 1-dB compression point occurs at the output IF power of +20 dBm. At room temperature, calculate (a) the overall system gain or loss in decibels, (b) the overall noise figure in decibels, (c) the minimum detectable signal in milliwatts at the input RF port, and (d) the dynamic range in decibels.

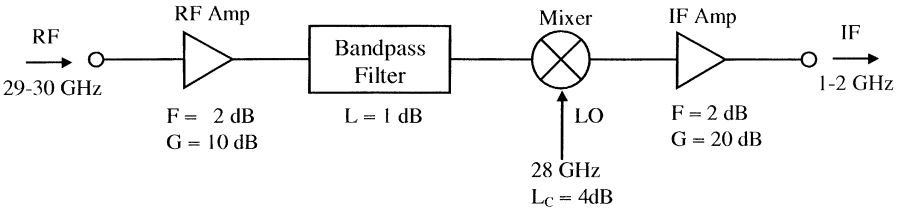

FIGURE P5.2

5.3 A receiver operating at room temperature is shown in Fig. P5.3. The receiver input 1-dB compression point is +10 dBm. Determine (a) the overall gain in decibels, (b) the overall noise figure in decibels, and (c) the dynamic range in decibels.

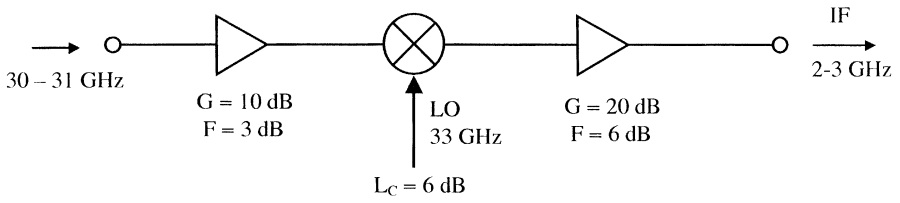

FIGURE P5.3

5.4 The receiver system shown in Fig. P5.4 has the following parameters: $P_{\text{in,1dB}} = +10$ dBm, $\text{IP3}_{\text{in}} = 20$ dBm. The receiver is operating at room temperature. Determine (a) the noise figure in decibels, (b) the dynamic range in decibels, (c) the output SNR ratio for an input SNR ratio of 10 dB, and (d) the output power level in dBm at the 1-dB compression point.

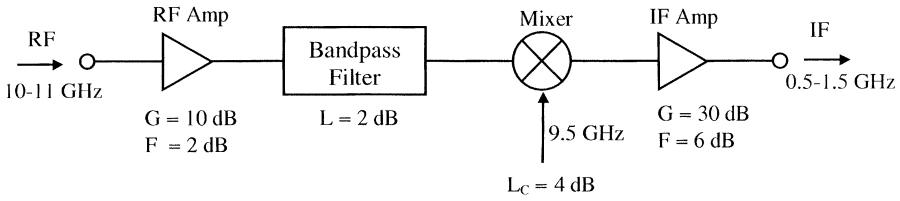

FIGURE P5.4

5.5 Calculate the overall system noise temperature and its equivalent noise figure in decibels for the system shown in Fig. P5.5.

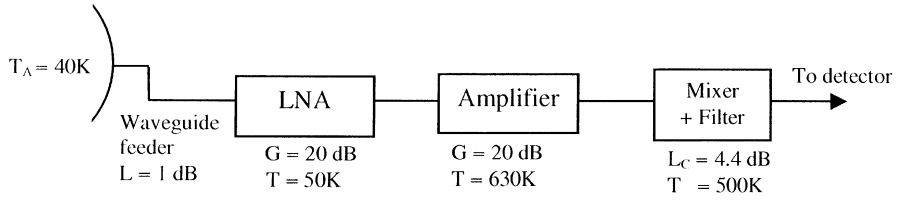

FIGURE P5.5

5.6 When two 0-dBm tones are applied to a mixer, the level of the IM3 is −60 dBm. The mixer has a conversion loss of 6 dB. Assume that the 1-dB compression point has input power generated greater than +13 dBm. (a) Indicate the IM3 power as how many decibels down from the wanted signal. (b) Calculate the IM3 output power when the level of the two tones is −10 dBm, and indicate the IM3 power as decibels down from the wanted signal. (c) Repeat part (b) for the two-tone level of +10 dBm.

5.7 At an input signal power level of −10 dBm, the output wanted signal from a receiver is 50 dB above the IM3 products (i.e., 50 dB suppression of the IM3

products). If the input signal level is increased to 0 dBm, what is the suppression level for the IM3 products?

5.8 When two tones of −20 dBm power level are incident to an amplifier, the level of the IM3 is −80 dBm. The amplifier has a gain of 10 dB. Calculate the IM3 output power when the power level of the two tones is −10 dBm. Also, indicate the IM3 power as decibels down from the wanted signal.

5.9 Calculate the overall system IP3 power level for the system shown in Fig. P5.9.

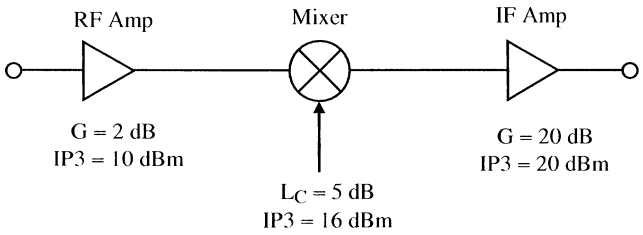

FIGURE P5.9

5.10 For the system shown in Fig. P5.10, calculate (a) the overall system gain in decibels, (b) the overall noise figure in decibels, (c) the equivalent noise temperature in kelvin, (d) the minimum detectable signal (MDS) in dBm at input port, and (e) the input IP3 power level in dBm. The individual component system parameters are given in the figure, and the system is operating at room temperature (290 K).

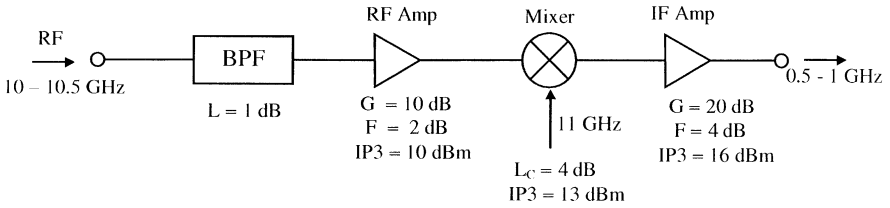

FIGURE P5.10

5.11 A radio receiver operating at room temperature has the block diagram shown in Fig. P5.11. Calculate (a) the overall gain/loss in decibels, (b) the overall noise figure in decibels, and (c) the input IP3 power level in dBm. (d) If the input signal power is 0.1 mW and the SNR is 20 dB, what are the output power level and the SNR?

5.12 In the system shown in Fig. P5.12, determine (a) the overall gain in decibels, (b) the overall noise figure in decibels, and (c) the overall intercept point power level in dBm at the input.

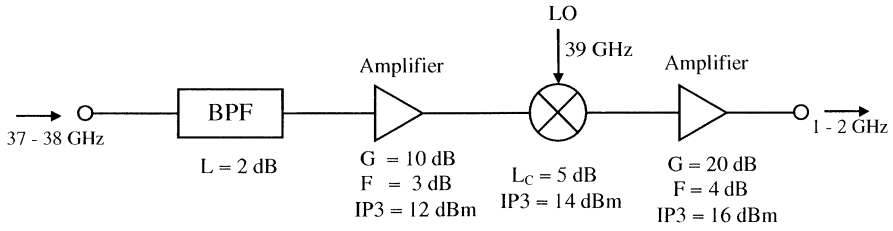

FIGURE P5.11

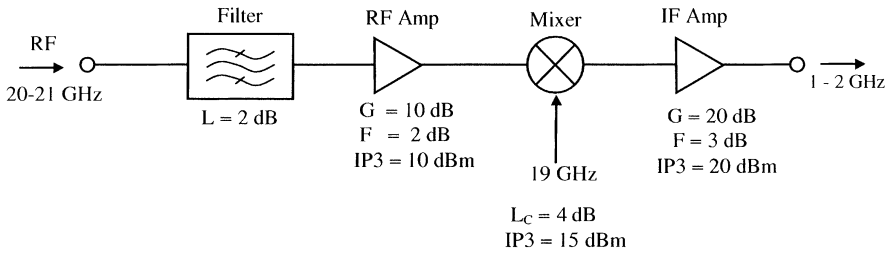

FIGURE P5.12

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